Innovate Triple Constraints Model for Better Construction Projects Results

N. F. Nouri*, and R. Marshal**

** Executive Vice President Office- Business support Division, Dubai Electricity and Water authority, P.O. Box 441906, Dubai, United Arab Emirates (E-mail: Nouri.nouri@dewa.gov.ae)*
*** Director in U.S.A, Chicago, USA (E-mail: marshall_pmp@comcast.net)*

ABSTRACT
The continuous changing impacts appeared in all solution understanding approaches in the projects management field (especially in the construction field of work) by adopting dynamic solution paths. The paper will define what argue to be a better relational model for project management constraints (time, cost, and scope). This new model will increase the success factors of any complex program / project. This is a qualitative research adopting a new avenue of investigation by following different approach of attributing project activities with social phenomena, and supporting phenomenon with field of observations rather than mathematical method by emerging solution from human, and ants' colonies successful practices.

The results will show the correct approach of relation between the triple constraints considering the relation as multi agents system having specified communication channels based on agents locations. Information will be transferred between agents, and action would be taken based on constraint agents locations in the project structure allowing immediate changes abilities in order to overcome issues of over budget, behind schedule, and additional scope impact. This is complex adaptive system having self organizes technique, and cybernetic control. Resulted model can be used for improving existing project management methodologies.

KEYWORDS
Ants, Complex system, Multi agent system, Project management triple constraints

INTRODUCTION
Project management triangle representing the first attempt to explain the relation between project triple constraints was first issued to public by Martin Barnes from United Kingdom on 1969, and the same was used officially in the "PMBOK" (PMI, 2000). In the traditional triple constraints triangle we have the scenario that everything will go well, but actually the decision making process is not clear which means losing the methodology of how to deals with various set of problems (Kerzner, 2006).

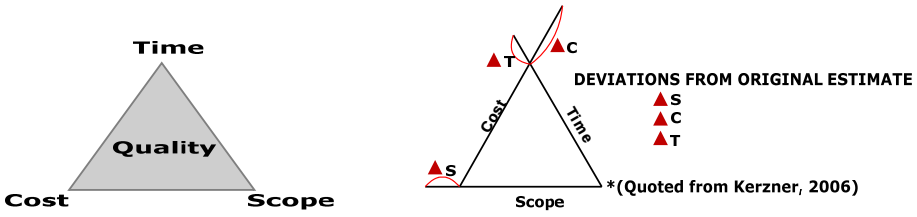

Figure 1. Problem in existing practise

Building pragmatist theory of project management practice was gone through chain of four phases (Figure 2) (Lalonde *et al.*, 2010). The first three phases show poor theory practices, although the

third phase start using social theories as a lunette to enrich understanding. The 4th phase goes deeply to handle the complexity of theory practice relationship in PM considering PM is practice not merely descriptive scientific discipline which means; considering a relation between activity and action (relation with humankinds which in this situation are project actors -agent-), and recommend to adopt project-grounded research which defines pragmatic theories of project management practice. Accordingly successful human practice the idea raised that social principle do have major impact of project success.

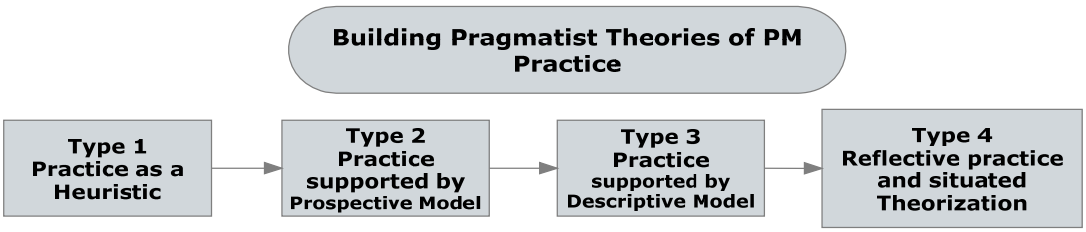

Figure 2. Research heuristic device path

From type 4 above, a new understanding for project management rose where project is about complex system that contains evolution of 1st order and evolution of 2nd order (figure 3), and act as a goal oriented system contain complexity (Saynisch, 2005).

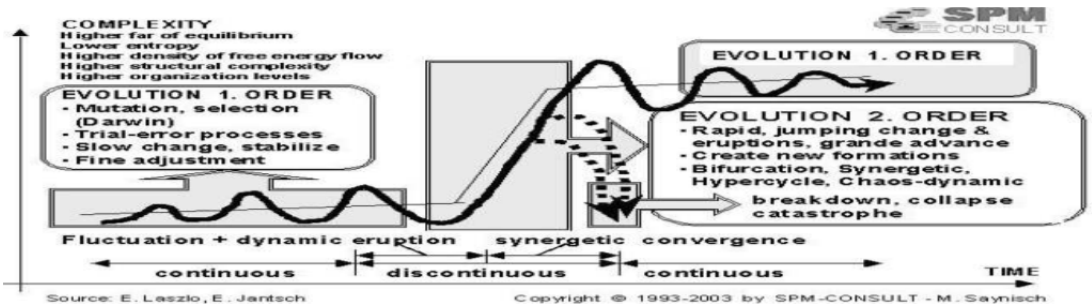

Figure 3. Evolution practice in project

Creativity in the project means taking action/decisions. In project reality, creativity can be better controlled by the comparison of the actual state and the target of vectors as shown in primavera shot (figure 4). Too early action (before reading the comparison result) will lead to unripe solution causing problem in realization phase, and may cause extra cost, delay in time ,and affecting scope .The key conflicts is to specify only one number for a goal (or mean value) to be achieved. But reality is variable; taking this into account to establish tolerances for goals, within which performance is considered acceptable (combined time, cost, and scope).

Figure 4. Reality sample from existing project

According to the evolution stage result, the solution output will pass to project team to develop ideas but this will pass through an advantage of possible control prior to implement in reality phase. Accordingly, the resulted heuristic device of this paper shows that the new understanding in project management will defined in four major elements control by cybernetic logic (figure 5).

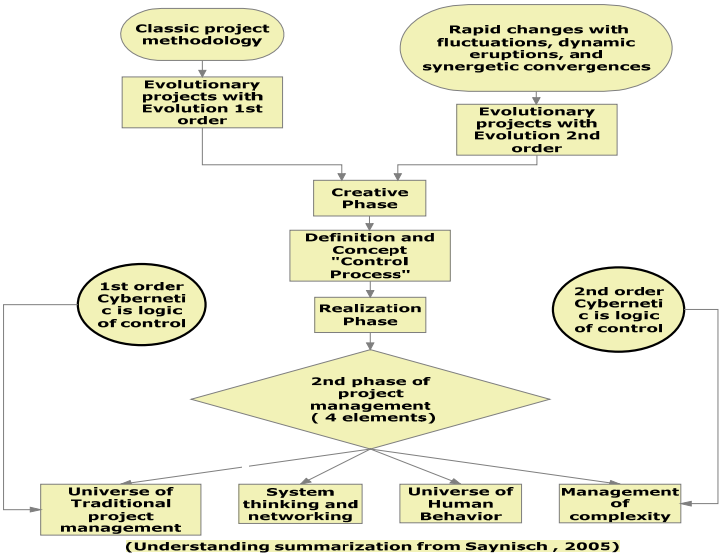

Figure 5. Research heuristic device results

Social factor and knowledge management

There is a strong relation between data and physical resources to represent the knowledge assets where more experience lead to less data consumption. Accordingly increase the usage sufficient of Knowledge assets (no waste of time, and less NOISE). The same will reduce the load factor on the communication channels. From that Information space (figure 7) was initiated (Boisot, 1999).

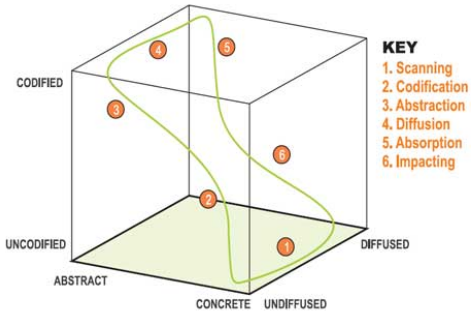

Figure 7. Information Space

METHODS

Model is a representation or a construction of a reality, and according to the heuristic device outputs explained as above (figure 5); this research methodology framework (figure 6) will emerge between the system modeling with grounded theory principle adopting a process called modeled based theory building (Schwaninger and Grosser, 2008).

Grounded theory

Grounded theory is method in which data collection, analysis & theory development are closely intertwined in the research process. This is closely connected in many ways with system thinking (-) and (+) feedbacks .Data collection and analysis tools used in grounded theory can be perfectly integrated in the system dynamics modeling process. On the basis that System Dynamic enables the construction of high quality theories, the quality of this model will be tested according to Patterson's eight criteria for evaluating theory (Patterson, 1986) which has been completed with two additional definitions by Holton and Lowe (2007). Markus Schwaninger and Stefan Grosser assumed most of these points could also be transferred to other methodologies of model building such as agent-based modeling (Schwaninger and Grosser, 2008).

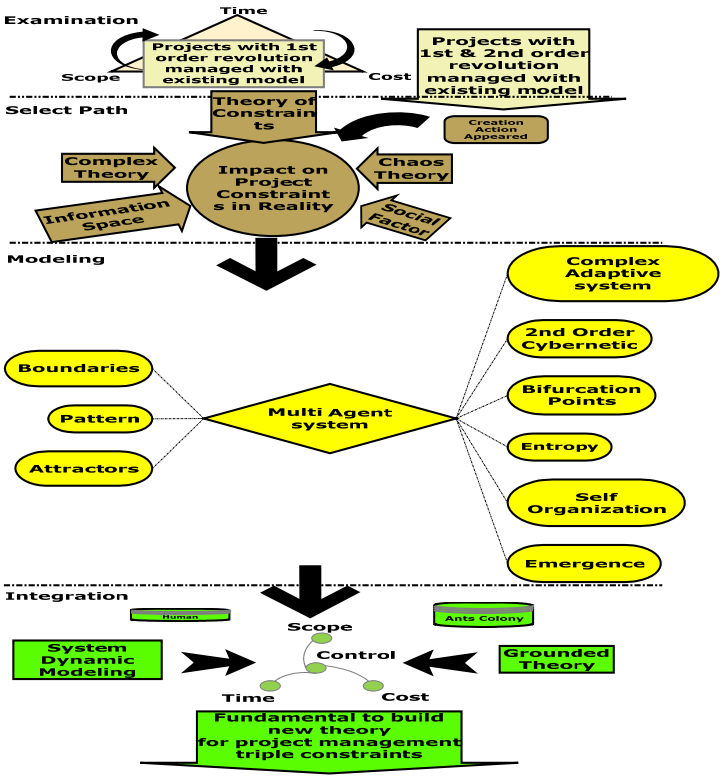

Figure 6. Research methodology framework

Ants

As evolution can be seen as essentially a tinkering process, whereby new structure arise from, and are constrained by, older ones, as an engineer can and must resort to whatever available techniques are appropriate. However, the remarkable success of social insects (they have been colonizing a large portion of the world for several million years) can serve as starting point for new metaphors in engineering and computers science.The daily problems solved by a colony include finding food, building or extending a new colony are all examples of projects. Many of these problems have counterparts in engineering and computer science. One of the most important features of social insects is that they can solve these problems in a very flexible and robust way: flexibility allows adaption to changing environments, while robustness endows the colony with ability to function even though some individuals may fail to perform their tasks. From that, Volvo have used the insect community to define innovate practices that was implemented in new design of robotic cars, and American army is taking their lessons learned from studying the life of ants. Ant behavior was the inspiration for the meta-heuristic optimization technique which leads to major successful complex system practices such as ant colony optimization. Complex adaptive behave for the model give the advantage of robotic social practice usually appeared in other socialites such as ants. Ants do divide their colony into troops. Each troop does a specific work for a specific time. Figure below shows the similarity in the conceptual model of TCCS in the ant colony structure. Ants work using self-organized methodology .Self organized methodology is working based on the learning process.

Knowledge Management

Ant colony is a self-organizing system using three communication channels between their members; two way chemical channels, and one way voice channel. Like human, ants do have their own voice language to communicate. Professor Jeremy Thomas (university of Oxford) stated “the main sound that controls the system is the queen voice” which in the resulted model of this paper is represented by “facilitate agent”. Ants do have their categories of work as agents defined for specific job with ability to change their scope whenever needed base on advice by higher controller according to the

colony needs. Successful human practice addressing three communication channels was defined by Bardyn and Fizgerald (Lissack and Gunz , 1999) supporting the hypothesis of this research that model should have communication channels with self-organizing mechanism for each agent.

Figure 8. Ant Colony structure

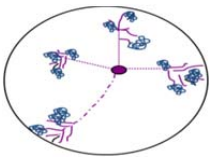

Figure 9. Ant colony section

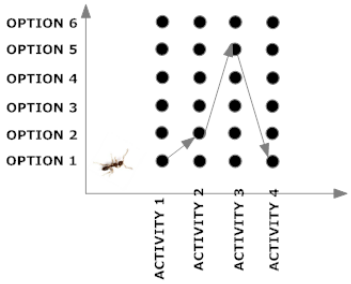

Figure 10. Ant path optimizing

RESULTS AND DISCUSSION

Model

The action does affect the environment which, in turn, affects future decisions of agents. Common property of agents is that they interact with their tasks environment as part of the problems solving process.

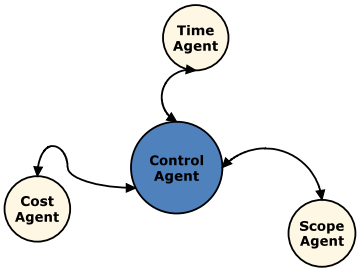

Figure 11. The new model

Proposed model is a multi-agent system. In the model, agents do respect constraints .An agent is a physical or virtual entity, which is capable of acting, not just reasoning. There are three agents that are responsible for the changes in any of the three constraints values; scope agent, time agent, and cost agent. These three agents are integrated through a control agent (figure 11). The model agents work as complex system components with self-organizing mechanism. The model title was defined based on analysis from the semiotic filed definition “Code”. Model title is Triple Constraints Code System “TCCS”.

Location in project structure

The model will be located in each level of the project work breakdown structure (WBS) considering project communities can reconfigure themselves to enable obtaining answers to questions within its own community (level of project structure). Accordingly in the project system, the model will work on the bases of sub system relations. Meaning; model on each (WBS) level will be a sub system of the higher level (under project system). The model consists of three agents who are responsible for the changes in any of the three constraints values these are; scope agent, time agent, and cost agent. For each administration level (project work breakdown structure level “WBS”) there will be control agents. On the top level of the WBS, the facilitating agent will be set (figure 12). In the model, the Key properties of agents in triple constraints code system (according to grounded theory principles); information position, autonomous action, cooperation of independent, building database knowledge, learning methodology, smart, and flexibility.

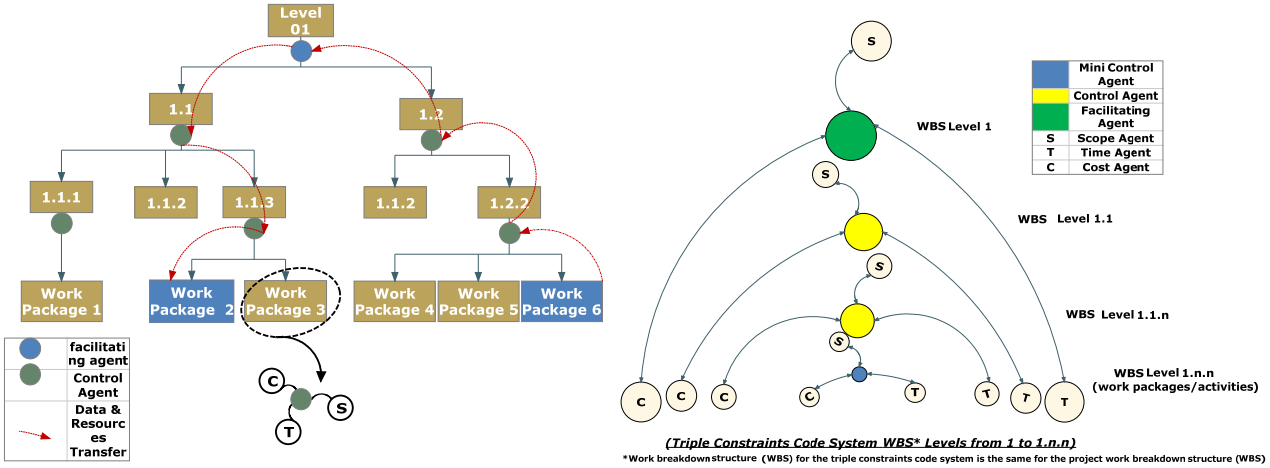

Figure 12. Model llocation in project structure

Model solution communication channels

Codification can mix between perceptual and conceptual (Boisot, 1999). Codification do have a major role in data transformation between system agents (channel between scope and scope ....etc.). Additional to that, codification can mix between different categories meaning that communication between control agents combining results of time, cost, and scope agents' feedback (Table 1).

Table 1. Model communication channels

Agent Name	No. of channels IN	No. of channels OUT	No. of critical channels
Mini control agent	**4**	**4**	**1**
Mini scope agent	**2**	**2**	**1**
Mini time agent	**2**	**2**	**1**
Mini cost agent	**2**	**2**	**1**
Control agent	**5**	**5**	**2**
Scope agent	**3**	**3**	**2**
Time agent	**3**	**3**	**2**
Cost agent	**3**	**3**	**2**

Complex system criteria in TCCS Model

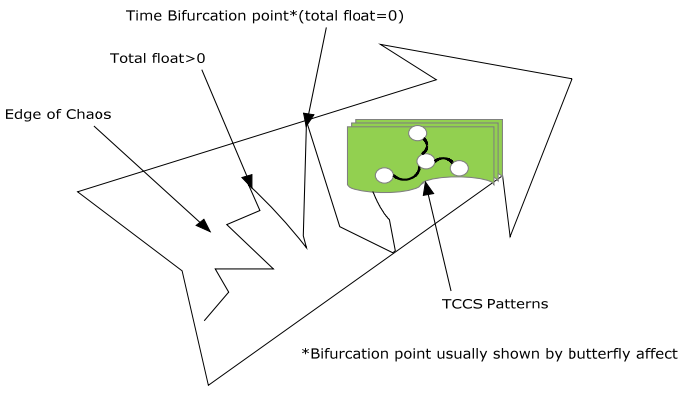

Figure 14. Bifurcation point impact

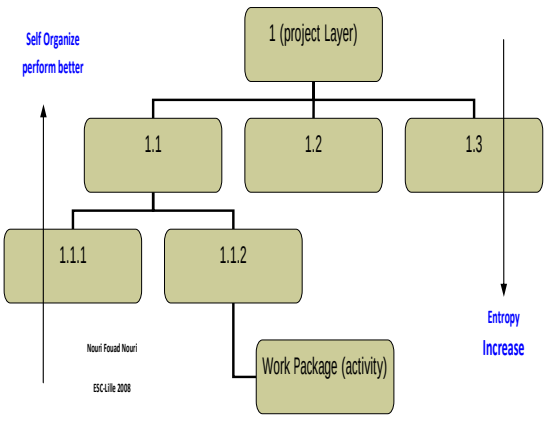

Figure 15. Model's entropy & self-organizing

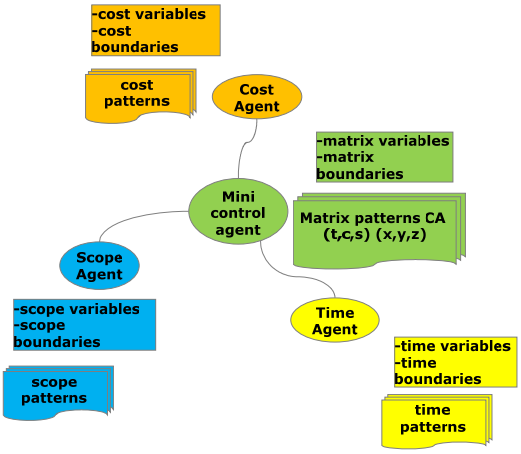

Figure 16. 2nd order Cybernetic in the model

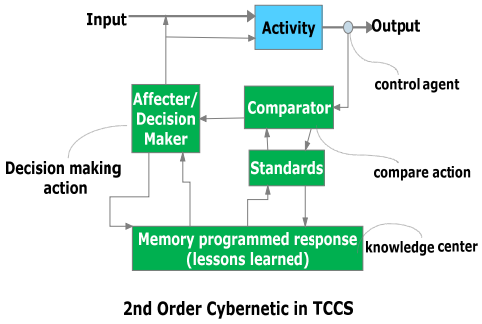

Figure 17. Model knowledge layer

System Thinking

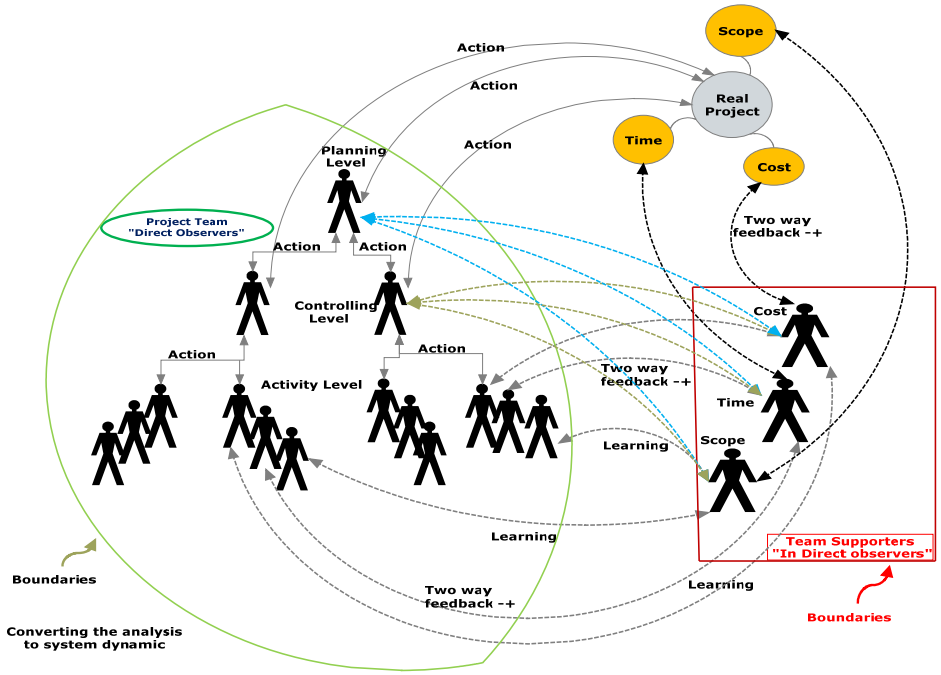

Figure 18. System thinking in the research model

CONCLUSIONS

- Triple constraints in project management are forming a complex system model as multi agent system (TCCS). It does not only reproduce the quality which is the output of the triple constraints integration but also explain behave of trade off role between them.

- New understanding of projects organization breakdown structure definition (figure 12).

- Project management software (Primavera, Microsoft Project etc...) shall have clustering observation system (figure 19). Cluster result shall define the action of priority by the higher level control agent, and for overall system will be the higher observer (facilitate agent) whom has the authority to change the overall system roles. Data clustering also will allow resource agents relocating to find match for the concerned control agent.

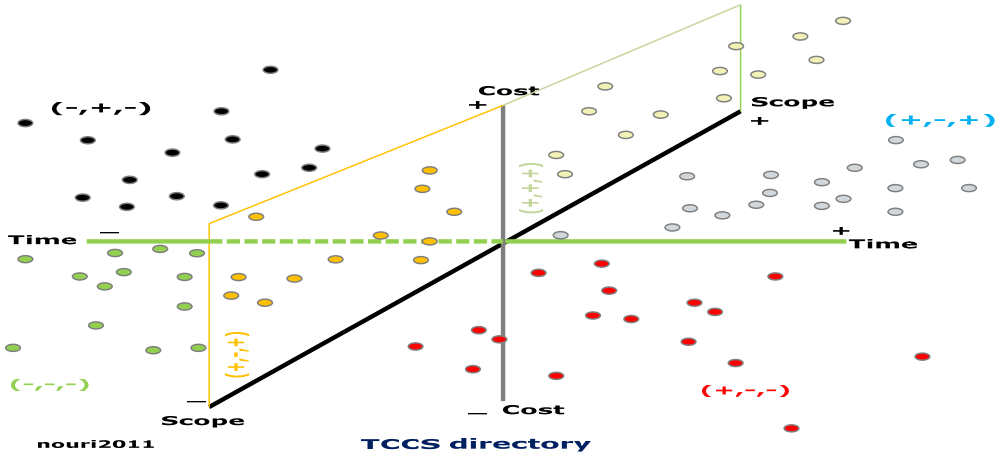

Figure 19. Activities clustering in TCCS model directory

- TCCS is integration between dynamic and social system. The missing chain that has been covered in this research is the relation between the triple constraints "activity" & the social elements "actions". Accordingly this model may be used to define the risk management plan.

- Using "Stigmergy" mechanism, the model social behavior will allow faster solving action due to decrease in interfering activities. The ideal result will be obtained with robots having altruistic behaviors especially for lower project level where entropy increased.

- The existing database may be barrier for effective decision making (Project internal agents are the main generators for NOICE). Therefore adaptability is required to unexpected events.

- As knowledge is well learnt when organized in a cooperative manner, TCCS model do work as composition primitive which mean re composing the knowledge of the three agents (time, scope, and cost) to be formed integrally in the control agent.

- Swarm intelligence integrated with 2nd order cybernetic is the advisable controlling mechanism for the TCCS model. Accordingly, control agent will take the required decision in the project system giving chance to raise the level of self-organizing practice.

REFERENCES

Kerzner H. (2006).*Project Management; A System Approach to Planning, Scheduling and Controlling), 9*. Ohio, USA: John Willy & sons, Inc.

Lalonde P., Bourgault M. and Findeli A. (2010). *Building Pragmatist Theories of PM Practice: Theorizing the Act of Project Management*. Project Management Journal, Vol 41, No. 5, Project Management Institute, Newtown Square, PA, USA, pp. 21-36.

Lissack M. R. and Gunz H. P. (1999). *Managing Complexity in Organizations: A View in Many Directions*, ABC-CLIO, USA

Boisot M. H. (1999).*Knowledge Assets: Securing competitive advantage in the Information Economy*, Oxford University Press, USA.

Saynisch M. (2005). *"Beyond frontiers of traditional project management": The Concept of "project management second order (PM-2)" as approach of evolutionary management.* Taylor & Francis Inc. Munich, Germany.

Schwaninger M. and Grosser S. (2008). *System dynamics as model-based theory building*. System Research and Behavioral Science, Sys. Res. (25), pp. 447-465.